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(54) **Manufacturing of fibrocement articles without asbestos fibre.**

(57) The invention relates to the production of manufactured articles in fibrocement without asbestos fibres. Said articles forseeing the need of a small amount of mechanically pre-treated cellulose fibres, the addition of cement, a flocculator, acidulate agents contrasting the tensions from expansion and reinforcement fibres in polyvinyl-alcohol and/or acrylic. The thermal conditioning of the manufactured articles carried out in a chamber with consecutive areas of different temeperatures is forseen after said articles have been formed.

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The present invention relates to fibrocement materials and more in particular to a method for the construction of articles, such as slabs, in fibrocement without asbestos fibres.

On one hand, the production of slabs in asbestos cement using a mixture of cement and asbestos fibres diluted in water, usually with a water/cement ratio of approximately 10, is well established, the asbestos fibres acting as both process and reinforcement fibres.

On the other hand, it is known that the use of asbestos fibres, even in construction materials, is forbidden in certain countries for sanitary and ecological reasons.

For this reason researches have been carried out for alternative solutions to asbestos cement construction materials without asbestos fibres.

Different solutions to the problem have been suggested in the English patents 1,605,004, 2,012,831, 2,073,317 and in the European patent application 81,303,957.5. Each of these solutions requires the realization of asbestos cement materials which substantially include particular cellulose fibres as process and reinforcement components. Their use can assure that the product which is still at the plastic stage has to be pressed and stabilized in autoclaves with saturated steam at a temperature of approximately 180° and pressure of approximately 10 Atm.

More in particular, in the Italian patent application number 67194-A/80, a process for the manufacturing of a hydraulically set material reinforced with fibres is claimed, characterized in that the fibres includes 2 to 20% in volume, as solids, of filtering or processing fibres and 1 to 10% in volume, as solids, of reinforcement fibres. Both types of fibres are put through a pre-treatment which tends to increase the dispersion in the suspension. This pre-treatment of the fibres is designed to make at least one compound, a salt, precipitate in or on the fibres so that they are combined with a first saline compound solution and then brought in contact with a second saline compound.

The process is therefore laborious, onerous and in practice uses:

- filtering or process fibres which allow the use of traditional machines for manufactured articles in fibrocement reinforced with asbestos fibres; and
- reinforcement fibres which grant the mechanical-physical characteristics required by the manufactured articles.

Thus, cellulose, waste paper, woolen fibres, silk, polyproylene fibres, rock wool and kaolin wool are used as process fibres and steel, carbon, glass, polypropylene, polyvinyl-alcohol, polyester, polyamides and polyacrylic are used as reinforcement fibres.

In each case, said fibres require a specific preliminary chemical treatment and the addition of a flocculator able to improve the retention of the solid particles for their dispersion in the mixture.

In practice, so as to achieve a positive result, the percentage of process and reinforcement fibres immersed in the dry mixture is usually high with respect to the one relating to asbestos fibres in articles manufactured with these fibres, even if this is not so in said Italian patent application. In particular, these percentages are approximately 7-8% in weight for process fibres and approximately 2-3% for reinforcement fibres, which in volume correspond to 14-16% and 4-6%, respectively.

It should therefore be noted that the specific gravity of these fibres is about half that of asbestos which, when going in the initial dry mixture, usually is about 11%, in weight. These alternative fibres therefore give the product, due to their high volume, a very low density (about 1.2 ÷ 1.3 g/cm3 against 1.6 ÷ 2 g/cm3 of the asbestos cement), thus achieving a low bending strength after the finished product has been immersed in water, in accordance with various European Standards. It is therefore necessary to work on the material being manufactured when it is still at the plastic stage with a pressing action of about 200 ÷ 250 kg/cm² so as to bring the density to 1.5 ÷ 1.6 g/cm3.

The results of the known techniques are not completely positive and reliable, especially because the cellulose contents (especially if in large quantities) is negative for the duration of the product and causes shrinkages of the slabs and their cracking, especially during very hot and dry weather.

Slabs of fibrocement which can be considered of a certain durability are those with:

- a minimum percentage of cellulose in the mixture so as to have a good retention of the cement particles during the slab forming process;
- a specific gravity of the slab of approximately 1.4 g/cm3 so as to have a good resistency against freezing;
- the presence in the mixture of primary substances of components to sufficiently contrast the tension of the shrinkages caused by cellulose in the mixtures; and
- a particular seasoning of the product in a conditioning chamber with controlled temperature and humidity.

The object of the present invention is to solve the problem of the manufacturing of articles in fibrocement without any asbestos in a new and original way, keeping in mind the above mentioned requirements ans with a new formulation of the process and reinforcement components.

It is infact an object of the present invention to allow the manufacture of articles with mechanical-physical characteristics similar to those of materials containing asbestos, but also without coming across inconveniences, defects, limitations and unreliability of the manufactured articles proposed in the above mentioned publications and, advantageously, without

having to carry out chemical treatments or pre-treatments, pressing operations and treatments in autoclaves.

Thus, in accordance with the present invention, the requirements in the formulation of the components to combine for the mixture designed for the manufacture of articles in fibrocement are:

- cellulose fibres in a quantity of 2 to 5% in weight;
- the addition of micro-silicon, sepolite or kaolin powders or fly ash in a quantity of 5 to 10% in weight;
- the addition of reinforcement fibres in a quantity of 1 to 3% in weight;
- the addition of agents contrasting the tensions from expansion of the finished product in a quantity of 5 to 10% in weight;
- the addition of as much Portland 325 cement as necessary;
- the addition of a flocculator in water; and after the articles have been formed,
- a final thermal conditioning for the seasoning of the articles in a chamber with a controlled temperature.

The low percentage of cellulose fibres improves the durability of the manufactured articles and reduces their risk of cracking due to shrinkages or thermal expansions. A weight percentage of 2 to 5%, preferably of 3 to 4% is retained to be the most satisfactory.

Furthermore, in accordance with the invention, said fibres are put through a preliminary mechanical treatment so as to achieve an optimal opening of the fibres themselves through a defibrating refiners which operate on cellulose solutions in water at 4-5% until it reaches a drainage value of 50-70° Shopper Riegler.

This drainage value is considered as being important so as to achieve a good retention of the cement particles in the Hatschek forming machine.

The addition of micro-silicon, sepiolite or kaoline powders or fly ash in a quantity of 5 to 10% in weight, preferably 7 to 8%, will give the layered damp material a good plasticity during the forming of the articles which is necessary for its shape, especially when regarding corrugated slabs, as well as obtaining a good adhesion between the various layers of laminations, avoiding the delamination of the same as they are usually made up of various layers.

Polyvinyl-alcohol based fibres and/or acrylic fibres of approximately 6 mm in length to a weight of 1-3%, preferably of 1.5-2.5%, are used as reinforcement fibres.

Wollastonite and/or mica of the above mentioned percentages are preferably used as tension contrasting agents. Infact, said powders in the form of acidulate constitute a micro-reinforcement inside the final mass which impedes any micro-flaws in the manufactured article.

The Portland cement used could contain a siliceous load and on the other hand the addition of a flocculator in water further improves the filtration properties of the formulated mixture.

Finally, the necessary thermal conditioning of seasoning of the manufactured articles is carried out in a chamber with a controlled temperature having a first area of 30 to 40°C, a second area of 50 to 60°C and a final area of 70 to 80°C.

The slabs remain inside the chamber for approximately 10 hours in an enviomment with high humidity so that the curing is achieved in the best possible way obtaining reliable and long lasting manufactured articles.

Claims

1) The production of manufactured articles in fibrocement without asbestos fibres, characterized in that requirements in the formulation of the components for the mixture designed for the manufacture of articles are:

- cellulose fibres in a quantity of 2 to 5% in weight;
- the addition of micro-silicon, sepiolite or kaoline powders or fly ash in a quantity of 5 to 10% in weight;
- the addition of reinforcement fibres in a quantity of 1 to 3% in weight ;
- the addition of agents contrasting the tensions from expansion of the finished product in a quantity of 5 to 10% in weight;
- the addition of as much Portland 325 cement as necessary;
- the addition of a flocculator in water; and after the articles have been formed,
- a final thermal conditioning for the seasoning of the articles in a chamber with a controlled temperature.

2) The production of manufactured articles in fibrocement as claimed in claim 1, characterized in that cellulose fibres, preferably in a quantity of 3 to 4% in weight, are used.

3) The production of manufactured articles in fibrocement as claimed in claims 1 and 2, characterized in that the cellulose fibres are put through a preliminary treatment and are mechanically opened in a watery solution of 4 to 5% until reaching a drainage value of 50 to 70% Shopper Riegler.

4) The production of manufactured articles in fibrocement as claimed in previous claims, characterized in that micro-silicon, sepiolite or kaolin powders or fly ash are preferably used in a quantity of 7 to 8% in weight.

5) The production of manufactured articles in fibrocement as claimed in the previous claims, characterized in that the reinforcement fibres comprises

polyvinyl-alcohol based fibres and/or acrylic fibres of approximately 6 mm in length to a weight preferably of 1.5 to 2.5%.

6) The production of manufactured articles in fibrocement as claimed in previous claims, characterized in that agents contrasting the tensions from expansion comprise products in the form of acidulate such as Wollastonite and/or mica which form a microreinforcement in the resulting structure.

7) The production of manufactured articles in fibrocement as claimed in the previous claims, characterized in that the Portland cement could include a silliceous load.

8) The production of manufactured articles in fibrocement as claimed in the previous claims, characterized in that the manufactured articles are seasoned by passing through a thermally conditioning chamber with a first area at about 30-40°C, a second area at about 50-60°C and a final area at about 70-80°C, the treatment being carried out for a total duration of approximately 10 hours in an enviornment with high humidity.

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EUROPEAN SEARCH REPORT

Application Number

EP 91 83 0309

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	GB-A-1 498 966 (CAPE BOARDS AND PANELS LTD) * page 1, line 47 - page 2, line 97; claims 1-3,18 * ---	1,6,7	C04B28/04 ///(C04B28/04, 14:04, 14:20, 16:06, 18:24, 40:02) (C04B28/04, 14:20, 16:06, 18:08, 18:24, 40:02)
A	WORLD PATENTS INDEX LATEST Week 8435, Derwent Publications Ltd., London, GB; AN 84-217052 & JP-A-59 128 253 (NOZAWA KK) 24 July 1984 * abstract * ---	1,6	
D,Y	EP-A-0 047 158 (DANSK ETERNIT-FABRIK A/S) * page 7, line 25 - page 11, line 10 * * page 12, line 17 - line 28 * ---	1-8	
Y	WORLD PATENTS INDEX LATEST Week 8835, Derwent Publications Ltd., London, GB; AN 88-242893 & DD-A-255 525 (VEB BAUELEMENT FASE) 6 April 1988 * abstract * ---	1-8	
A	EP-A-0 015 538 (KUBOTA LTD) * claims 1-4,10,11 * ---	1,2,6	TECHNICAL FIELDS SEARCHED (Int. Cl.5) C04B
A	GB-A-2 083 512 (AMFU LTD) * the whole document * ---	1,2,4,6, 7	
A	CHEMICAL ABSTRACTS, vol. 105, no. 10, 8 September 1986, Columbus, Ohio, US; abstract no. 84269S, page 346 ; * abstract * & JP-A-61 031 337 (KURARAY CO. LTD) 13 February 1986 --- -/--	1,2,6	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 JANUARY 1992	THEODORIDOU E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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EUROPEAN SEARCH REPORT

Application Number

EP 91 83 0309

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	CHEMICAL ABSTRACTS, vol. 105, no. 8, 25 August 1986, Columbus, Ohio, US; abstract no. 65386M, page 306 ; * abstract * & JP-A-61 026 544 (KURARAY CO. LTD) 5 February 1986	1,2,4,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 JANUARY 1992	THEODORIDOU E.

EPO FORM 1503 03.82 (P0401)

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document